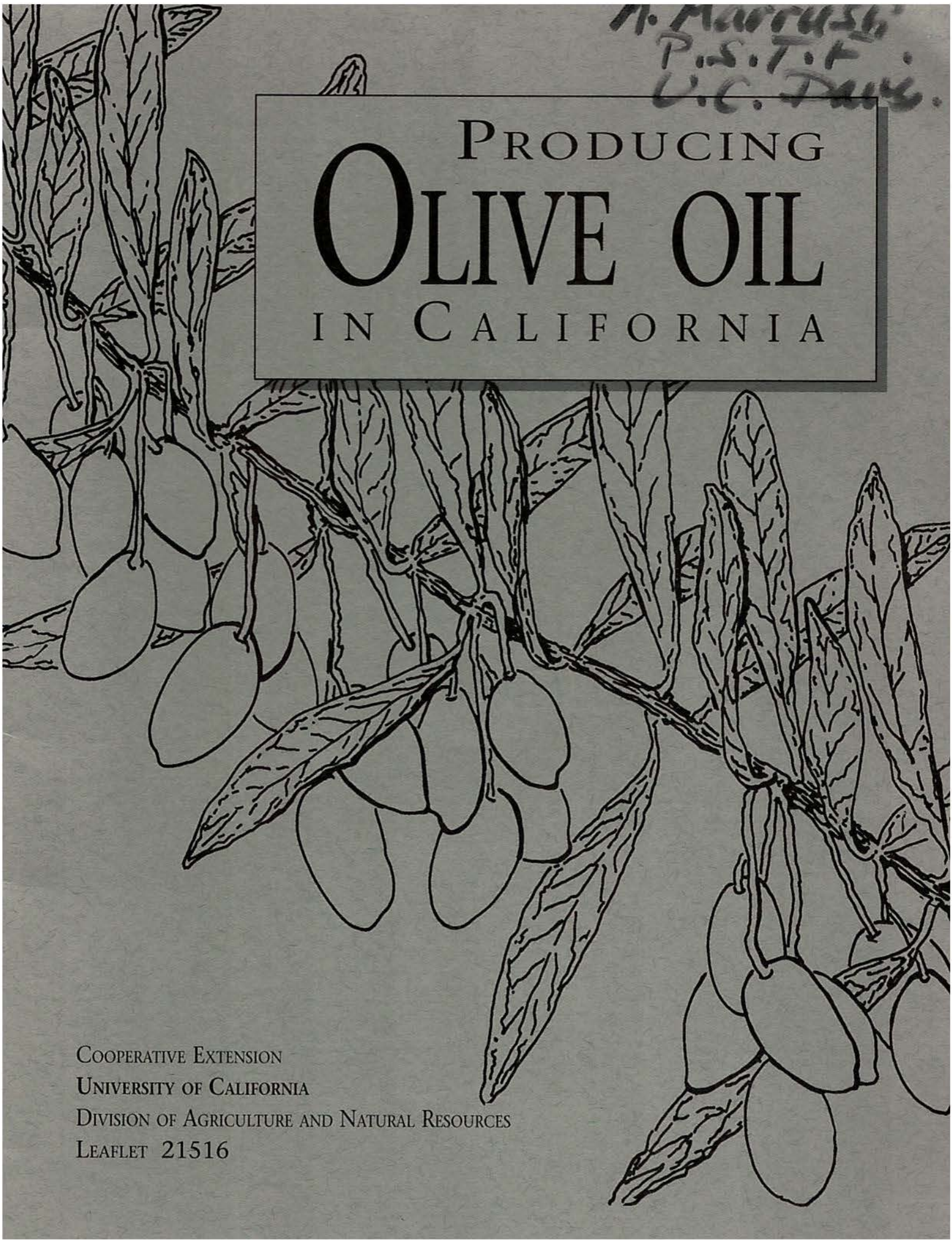
R. Marcus
P.S.I.T.
U.C. Davis.

PRODUCING OLIVE OIL IN CALIFORNIA



COOPERATIVE EXTENSION
UNIVERSITY OF CALIFORNIA
DIVISION OF AGRICULTURE AND NATURAL RESOURCES
LEAFLET 21516

Olive oil producers in California have formed an association to provide cultural and marketing education and promote olive oil. The Northern California Olive Oil Council (P.O. Box 675, Rutherford, CA 94573) welcomes new members.

Publication 21516

For information about ordering this publication, write to

Publications
Division of Agriculture and Natural Resources
University of California
6701 San Pablo Avenue
Oakland, California 94608-1239

Telephone (510) 642-2431
FAX (510) 643-5470

©1994 by The Regents of the University of California
Division of Agriculture and Natural Resources

All rights reserved.

No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the written permission of the publisher and the authors.

Printed in the United States of America.

To simplify information, trade names of products have been used. No endorsement of named products is intended, nor is criticism implied of similar products that are not mentioned.

The University of California, in accordance with applicable Federal and State law and University policy, does not discriminate on the basis of race, color, national origin, religion, sex, disability, age, medical condition (cancer-related), ancestry, marital status, citizenship, sexual orientation, or status as a Vietnam-era veteran or special disabled veteran. The University also prohibits sexual harassment. This nondiscrimination policy covers admission, access, and treatment in University programs and activities.

Inquiries regarding the University's student-related nondiscrimination policies may be directed to the Affirmative Action Director, University of California, Agriculture and Natural Resources, 300 Lakeside Drive, 6th Floor, Oakland, CA 94612-3560, (510) 987-0096.

1.5m - rep - 12/96 - LTE/WJC/VFG

♻ printed on recycled paper

Producing Olive Oil in California

The authors are G. Steven Sibbett, UC Cooperative Extension Farm Advisor, Tulare County; and Joseph Connell, UC Cooperative Extension Farm Advisor, Butte County.

This publication provides a general overview of the olive oil industry with a brief history of olive oil, an introduction to olive oil production, and current statistical data about olive oil. It also contains oil specifications, basic manufacturing processes, and unique cultural and economic considerations required for olives grown exclusively for oil.

Olive Oil History

The earliest olive oil production occurred approximately 6,000 years ago when oil was traded by a Semitic race of people in Syria. These ancient Palestinians grew olives and exported oil to Egypt, where devotees of the goddess Isis first used olive oil as an anointing oil in religious ceremonies, as well as in the diet.

The Minoan culture in Crete was also included in the origin of olive oil. Minoans produced and traded in olive oil as long ago as 2500 B.C. Some reports say the olive tree was native to Crete because it was called *Elaia*, a Greek name; if it had been introduced to Crete from the Palestine region, a Hebrew name would presumably have been used. From Crete, olive culture and the use of olive oil spread to Greece. The Greeks are credited with propagating the use of olives and olive oil throughout the Mediterranean countries.

Biblical references to olives and olive oil are many. In the book of Genesis, Noah's dove returns to the ark with an olive sprig as evidence of a refreshed earth. Noah's recognition of an olive branch suggests it was a well-known tree at that time. Perhaps the best reference to the religious significance of olive oil is in the book of Exodus, where Moses was told by the Lord how to make an ointment of oil and spices. In addition to an ointment, olive oil was used as a food, a lubricant, a medicine, a salve, and a lamp fuel. The biblical books of Leviticus and Judges also contain references to olive oil, as does the Moslem Koran.

Olive tree cultivation and olive oil production were extended throughout the Mediterranean and northern African countries by Roman and Arab cultures. In the early 1700s, Spanish Jesuits brought olives to the early missions of Mexico. In 1769, Franciscan padres from Mexico founded the first California mission at San Diego de Alcalá. Within two decades, California olives, most likely grown from cuttings, were being pickled for table use and processed into oil. The first written account by Father Lausen in 1803 indicated that Mission San Diego de Alcalá had harvested olives and produced some very good oil.

After the Mission era, the first commercially produced olive oil in California came from the Camulos oil mill in Ventura, established in 1871. By 1885, California olive growers found that their oil was as fine an oil as was produced anywhere, and that resulted in significantly increased production and sharply lower prices. These same growers could no longer compete with the still-low prices of imported oils, and production of oil in California declined. Since 1900, the industry has largely confined itself to producing pickled table olives. The production of olive oil in California has been a "salvage" operation, which utilizes cull fruit from a pickling plant or from fruit left unharvested.

In addition to California and countries surrounding the Mediterranean Sea, olive cultivation and oil production areas now include Argentina, Australia, Brazil, Chile, Japan, Mexico, and the Republic of South Africa. Spain and Italy currently dominate world olive oil production, with Greece as the third-largest producer. These three countries account for approximately 80 percent of world olive oil production and 75 percent of olive oil consumption. The United States produces less than 0.1 percent of the world's olive oil, but consumes 3 to 4 percent.

Since the decline in olive oil prices in the early 1900s, only a small number of oil producers in California have remained. Most oil produced in California is "pure" olive oil, which is a blend of "refined" olive oil and "virgin" olive oil, which is added for flavor. Several producers sell limited amounts of virgin oil to more specialized markets.

About Olive Oil

In addition to culinary uses, olive oil, an unsaturated fat, has long been valued for its medicinal uses. Ancient clinical reports included olive oil as both a topical and internal medicine that cured such illnesses as skin disorders, gallstones, obesity, diabetes, multiple sclerosis, high blood pressure, excessive bone growth, and, in one report, the external auditory canal. Olive oil was also said to reduce the aging process.

Recently, more experimental data have been gathered about health benefits of olive oil, and it is now suggested that it is a good fat to use in foods. It has been shown to reduce blood serum cholesterol and subsequent heart and vascular disease. Olive oil has also been shown to lower gastric acidity, thereby protecting against ulcers.

Today, health benefits of olive oil are attributed to its unsaturated fatty acid content, primarily its oleic and linoleic acids. Oleic acid, a monounsaturated fatty acid, makes up 55 to 85 percent of olive oil. Monounsaturates are thought to reduce harmful cholesterol by increasing high-density lipoproteins (HDL) that carry cholesterol from the blood system. Linoleic acid, making up about 9 percent of olive oil, is a polyunsaturated fatty acid and is also associated with low blood cholesterol levels. The remainder is made up of various fatty acids.

Olive Oil Quality

It is important to understand olive oil quality if one is to produce this oil. Quality includes the oil's acidity (from oleic acid) and such organoleptic characteristics as aroma and flavor. Oil flavor varies with the growing location, the variety and quality of olives, and the method of harvesting. Oil color varies considerably, but is not an indicator of quality, since color does not influence flavor. Oil color depends on the olive cultivar, climatic growing region, fruit maturity, physical fruit condition at harvest, and the processing and handling methods. Good-quality oils are usually light yellow to greenish in color.

Marketing and Standards

Olive oil is a world commodity, like wheat or sugar, and its production and labeling are controlled by international agreement. In 1959, an International Olive Oil Agreement was developed for olive oil, and the agreement is administered by the International Olive Oil Council in Madrid, Spain. This agreement was changed in 1979 and again in 1986, with amendments added in 1990 and 1991 (now considered to be the current agreement) to include strict organoleptic (taste and aroma) and acidity standards for olive oil.

The agreement designates "olive oil" as oil obtained solely from the olive, and it excludes any oil extracted from olives by solvents or re-esterification processes, and any mixtures of olive oil with other oils. The designation "pure olive oil" cannot be applied to any residue oils

from olives. There are three types of olive oil: virgin olive oil, refined olive oil, and olive oil or pure olive oil.

Virgin olive oil is obtained from the fruit of the olive tree solely by mechanical means under conditions (particularly thermal conditions) that do not lead to deterioration of the oil. The olive fruit must not have undergone any treatment other than washing, decantation, centrifugation, and filtration. Virgin olive oil cannot be obtained by solvent or re-esterification processes, nor can it be mixed with oils of other kinds.

The descriptive terms "extra," "fine," and "ordinary" or "semi-fine" describe virgin olive oils. Extra virgin olive oil is also labeled simply extra, or virgin olive oil extra, or extra vergine (Italian) or vierge extra (French). It is the pure, unadulterated oil from top-quality olives and has perfect organoleptic characteristics (taste and odor, see Appendix, page 10) as judged by a group of selected tasters working as a panel. Extra virgin olive oils have strong flavors that vary only with the year produced and olive cultivar. However, most established oil packers mix oils from various regions and cultivars having different flavors to obtain a specific flavor and color. Thus, the consumer always gets the same flavor and color from a specific brand of oil.

Extra virgin olive oil has an average organoleptic rating of more than 6.5 (on a scale of 1 to 9, with 1 being worst and 9 being best) and a maximum free acidity in oleic acid of not more than 1 gram per 100 grams of oil (1% by weight).

Fine virgin olive oil is also called virgin olive oil fine or "fino." It also has perfect taste and odor but has less organoleptic quality, more than an average rating of 5.5, and is slightly more acidic than extra virgin oil, containing not more free acidity than 1.5 grams of oleic acid per 100 grams of oil.

Semi-fine or ordinary olive oil—also called virgin olive oil semi-fine, virgin olive oil ordinary, "corriente," or "semifino"—is virgin olive oil with good taste and odor, and average organoleptic rating of 3.5 or more, and a maximum free acidity of 3.3 grams of oleic acid per 100 grams of oil.

Virgin olive oil not for human consumption is termed "lampante virgin olive oil" (lamp oil). It has an off-taste flavor with an average organoleptic rating of less than 3.5 and/or free acidity greater than 3.3 grams of oleic acid per 100 grams of oil. This oil is destined for refining or for technical uses.

Refined olive oil is the oil obtained from virgin olive oil by refining methods that do not lead to alterations in the initial glyceridic structure. It has certain organoleptic characteristics or other properties that must be corrected by refining. In the refining process, caustic soda (lye) is used to purify, decolorize, and deodorize the oil. Many times refined oils are the product of damaged olives or culls from a pickling operation.

Olive oil (or pure olive oil) is a blend of refined and virgin olive oils and is often labeled as Pure Olive Oil. Many imported brands sold in the United States are "pure," or "100% pure" olive oils that have been blended to obtain the uniformity of taste and color desired by the American consumer. Most California oil is blended to make pure or 100 percent pure olive oil.

Crude olive-pomace oil is the oil obtained by treating the olive residue (pomace) from previous pressings with solvents. It excludes oils obtained by re-esterification processes and mixture with oils of other kinds. It is intended for subsequent refining for human consumption, or for technical use. It is further classified as either refined olive-pomace oil (oil intended for food use), olive-pomace oil (blend of refined olive-pomace oil and virgin olive oil), or olive-pomace oil for technical use (all other crude olive-pomace oils).

Producing Olive Oil

Economic Considerations

Most olive oils produced in California must be priced competitively with less expensive, imported, or refined olive oils. Consequently, most California olive oil sold is produced as cheaply as possible. The producers commonly salvage low-cost, cull olives from pickling operations, or gather unharvested fruits from table fruit orchards owned by other people, thus avoiding the costs of growing the fruit. Oil producers cannot afford to pay high production costs to grow olives for pure olive oil; therefore, few cultivate them exclusively for that purpose. Virgin olive oils of high quality are produced in California and are sold locally in specialty markets for premium prices. Even so, premium

olives are still more profitable when pickled than when pressed for virgin oil. Specialty olive oil operations must use cheap olives for virgin oil production if the product is to be profitable.

There are two economic components to the olive oil business: obtaining the olives and producing oil. One must decide if the operation will be exclusively an oil-processing business or if it will include an olive farming operation that grows olives for oil or table use, or for both. Land, labor, and cultural costs are high and must be recovered from the production of olives and sale of the oil. It is recommended that one carefully analyze the economics of olive farming, oil processing, and the market potential for oil.

Cultural Considerations

The following discussion is limited to the unique requirements for growing olives exclusively for oil.

When growing olives for oil, the objective is to produce a heavy tonnage of fruit suitable for high-quality oil every year. The site where olives are grown, the olive cultivar, and harvest practices influence production and oil quality.

Site. Soil type and local climate are important considerations when selecting the site to grow olives.

Highest oil percentage has been recovered from crops of moderately vigorous trees. Tree vigor is influenced by soil type and water status. An ideal site for oil olive production has a clay loam soil with a high water-holding capacity and good internal drainage. Deep, sandy loam soils, suited to other tree crops, should be avoided, since olive trees grow too vigorously to produce well on these soils. Due to the lower water-holding capacity of sandy loam soils, frequent irrigations would be required to maintain optimal water status, often resulting in the production of lower-quality, "watery" oils. Largely because of soil variation, olives grown on heavier soils of Northern California tend to have a higher average oil content than olives grown in sandy loams of the San Joaquin Valley.

The oil olive growing site should be free of hard winter and early fall freezing. It should have long, hot, rain-free summers to mature the fruits for maximum oil content. The olive is a subtropical plant with small wood that may be injured by temperatures below 25°F. Major limb injury, heavy leaf loss, or tree death can occur when temperatures fall below 15°F. Except in the case of special-use oils produced from immature fruit, oil olives will normally be harvested in November and December when full maturity is reached. Sites where the probability of frost is high prior to maturity should be avoided. Frost injures olive fruit, stops oil accumulation, and renders fruit unsuitable for high-quality oil yield.

Olive cultivar. A high-quality virgin olive oil is usually derived from the fruit of one olive cultivar. Quantity and quality (acidity and flavor) of such oils are highly dependent on the olive cultivar used. The quality of olive oils blended and refined with virgin oils is adjusted in the blending process, and is not cultivar-dependent.

Most olive cultivars range in oil content from 10 to 35 percent of their fresh weight at full maturity (see table 1). Cultivars with an average oil yield of less than 20 percent (53 gallons of oil per fresh ton of fruit on a fresh-weight basis, olive oil at 7.61 lb per gallon) are not usually profitable to grow for oil. Of the major cultivars commonly grown for table fruit, Sevillano is the least desirable for oil due to its low oil content and in some cases poor flavor; Manzanillo, the most widely planted table olive, has a marginal oil content but produces a sweet oil; and Mission averages 22 percent oil content by fresh weight and produces a good-quality oil. The cultivar selected for olive oil production should also yield annually.

Olive oil flavor is influenced by the olive cultivar used to make the oil and by the region where it is grown. Olive oil packers commonly blend unique virgin oil flavors attributed to both cultivar and region to obtain a flavor and color that can be attributed to their specific brand.

Crop size. Oil yields per fresh ton, derived from cull and undersized canning fruit, depend to some extent on crop size. For any given cultivar, heavy crops yield a lower percentage of oil per fresh ton than light crops because fruit from a heavy crop typically do not attain the same level of maturity as fruit from light crops. Yields of olive oil on a per acre basis are moderated somewhat by the inverse relationship between oil percentage on a fresh-weight basis and crop size.

The olive cultivar selected for oil production must yield well to be competitive. Olive trees are alternate bearing: that is, a heavy crop is usually followed by a light crop the next year. Cultural

Table 1. Approximate range in oil content on a fresh-weight basis of selected olive cultivars*

Cultivar	Percentage oil when black ripe without shrivel: Percentage oil (fresh weight)	Approximate harvest date
SMALL FRUIT		
Arbequina	21	Jan
Chemlali	26–28	mid-Dec
Coratina	20–28	Jan
Frantojo	25	Dec
Grappolo	15–34	mid-Dec
Leccio del Corno	24	Jan
Lucca	19–27	Feb
Moraioli	18–32	mid-Dec
Pendolino	17–22	Dec
Redding Picholine	15	Dec
MEDIUM FRUIT		
Dolce del Marocco	25–26	Dec
Grossa di Spagna	26–27	Dec
Grosse Aberkan	23	Jan
Leccino	22–23	Dec
Macrocarpa	14–16	Dec
Manzanillo	15–26	mid-Dec
Maurini	13–25	Feb
Mission	19–24	Dec–Jan
Nevadillo	25–26	Feb
Obliza	20	Dec
Picual	21	Dec
Saint Catherine	21–28	Feb
Salonenque	24	Dec
LARGE FRUIT		
Ascolano	19	Feb
Barouni	13–18	mid-Dec
Sevillano	12–17	mid-Dec

*Fruit picked black-ripe in December, January, and February.

Sources: Hartmann, H.T., et al. 1951. *Olive Varieties.* Univ. of California Agric. Exp. Station, Bulletin 720; and Martin, G.C., 1992, personal communication.

practices such as pruning should be employed to keep crops steady from year to year. Best overall oil yields are obtained from moderate crops produced on an annual basis.

Harvest management. Oil percentage and acidity of olive fruit increase as the fruit mature to the black stage (fig. 1). The best-quality oil comes from olives that have matured to the red-ripe stage, when the flesh is developing a purple color. However, uneven fruit maturity precludes "once-over" harvest, and multiple harvests must occur if one is to harvest all the fruit at the red-ripe stage of maturity. Such harvesting is costly and adaptable only to small operations where picking labor can be closely controlled. Fully mature, black fruit make good quality oil too, but the fruit are soft and may be damaged easily during harvest. Harvest damage results in a high-acid, poor-quality oil. Late-harvesting black fruit (in January) also causes lighter cropping the following year. Immature, green olives or straw-colored olives are sometimes gathered because of the unique flavor such less-mature fruit imparts to oil. Oil produced from these fruit may have a sharper, more acrid flavor that some find desirable.

Harvesting olives for high-quality virgin oils requires as much care as harvesting for table fruit. In each instance, the fruit should be hand picked to avoid damage. Olive oil takes on odors and flavors readily. If the olives come into contact with the ground or are damaged during the harvest, the oil takes on different, less-desirable flavors. Oils from fruit harvested black or fruit damaged during harvest are destined to be refined to eliminate off flavors and colors. Machine harvest with tree shakers and catching equipment is best used in salvage operations where frosted and overripe fruit are gathered and the resultant oil is used for refining.

Postharvest handling also affects olive oil quality. For example, olives left in bins for extended periods before pressing will ferment and mold. The oil takes on a disagreeable flavor and must be refined.

Other cultural practices. Most cultural practices required for best oil olive production are the same practices used for table olives, especially pruning, fertilization, irrigation, and pest and disease control. See UC ANR Publication 3353, *Olive Production Manual*, for a thorough discussion of cultural practices appropriate for olive production.

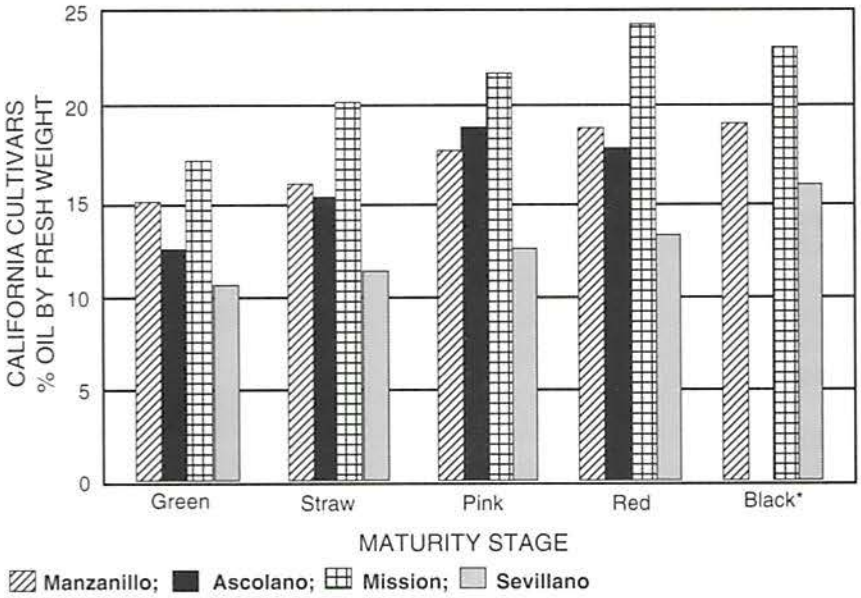
Olive Oil Processing

Olives for high-quality oil should be delivered to the oil plant as soon after harvest as possible. Vented containers should be used to avoid heat buildup and fruit damage during transit and storage.

Olive fruit are first washed to remove soil and leaves that would impart a poor taste to the oil. After washing, oil processing includes (1) crushing the fruit and mixing the mash, (2) separation, (3) pressing, (4) refining (if necessary), and (5) separating the water from the oil.

Crushing and mixing. The olive fruit are crushed into a paste that can be pressed for oil extraction. Crushing tears the flesh of the olive and releases the oil. The pits are crushed too, and are essential in the shredding process. Older olive crushers, some of which are still in use in smaller oil plants (fig. 2), use large granite millstones to crush the fruit. Most modern plants use an auger or screw-type hammer or counter-rotating crusher grate (fig. 3).

After the olives have been crushed, the resultant paste must be mixed, a very important step because it prepares the paste for separation into solid and liquid phases. Mixing the paste (often called mash at this stage) merges the oil droplets to increase the percentage of oil that can be separated from the oil-water emulsion. The mixing step is less important where roller crushers are used, since the paste is essentially mixed during the crushing process. Figure 4 shows a mixer-spreader.



*Data not available in this study for Ascolano. See table 1.

Figure 1. Olive oil content versus fruit maturity.
(*Source: Association of Official Agricultural Chemists*, Vol. XVIII, No. 3.)

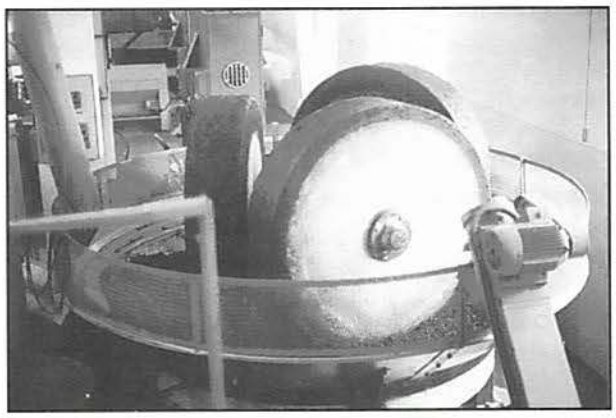


Figure 2. Millstone crusher with three granite wheels for crushing olives.

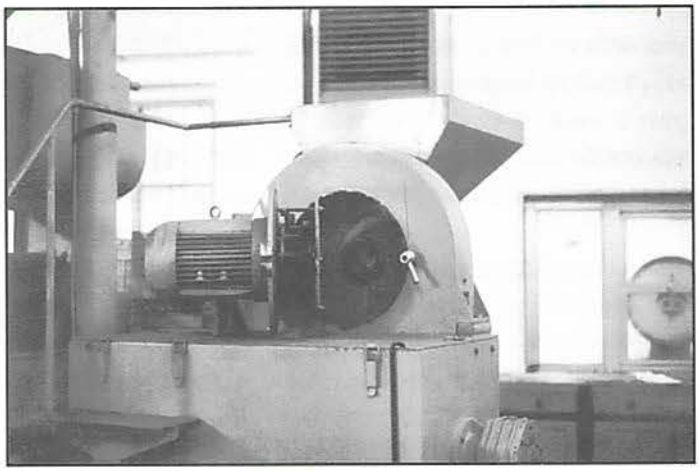


Figure 3. Metal moving-hammer olive crusher.

Separation. Pressing the paste to divide the liquid (oil) and solid phases is called separation. Techniques commonly used are pressing or centrifugation, and percolation (or selective filtration).

Pressing involves squeezing the paste to extract the oil. Following a traditional millstone crushing operation, the paste is spread on mats made of nylon or hemp (fig. 5). The mats are then stacked in a hydraulic press and hundreds of tons of pressure are applied to extract the oil-water mix that drains into a tank below the press (figs. 6 and 7). Modern screw- type machines and counter-rotating grates crush and press the mash in a single process (see fig. 3).

Centrifugation applies centrifugal force to a water-diluted paste to permit continuous, simultaneous separation of the oil, water, and pomace (fig. 8). Centrifugation is a faster, continuous process limited only by the size of the centrifuge decanter. If the decanter is overloaded, extraction yield declines, since the paste does not have enough time to separate cleanly. Also, extraction yield is affected by the proper preparation of paste with water and by excessive temperature of the paste-diluting water.

Percolation uses the principle of the differing surface tensions of oil and vegetable water with respect to a steel plate. When a steel plate is plunged into an olive paste, the oil preferentially coats the plate. When the plate is withdrawn, it is coated with pure oil. Percolation efficiency ranges between 40 and 75 percent, depending on the condition of the olives (low-moisture, high solid matter is preferred), and duration of the process. Percolation leaves a very wet, oily must that has to be further pressed or centrifuged to extract the oil. Combined continuous percolation-centrifugation is the process most widely used.

Separation processes are presented diagrammatically in figure 9.

Separating oil from the must. Once the olives are pressed, centrifuged, or percolated, the resultant oily must has to undergo one additional process to fully separate the remaining oil from

Figure 4. Small-scale mixer-spreader.

Figure 5. Worker spreading olive paste on mats.

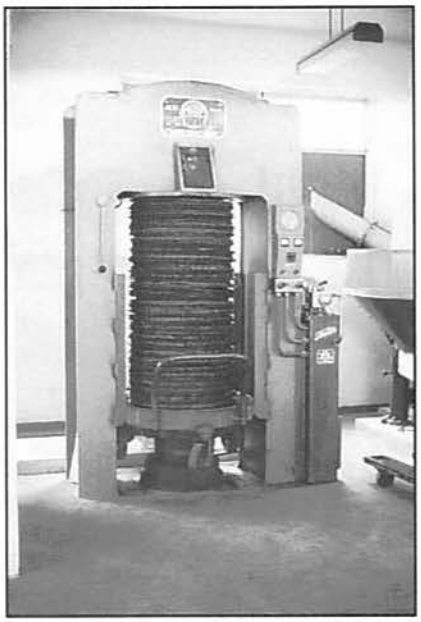


Figure 6. Initial loading of the press.

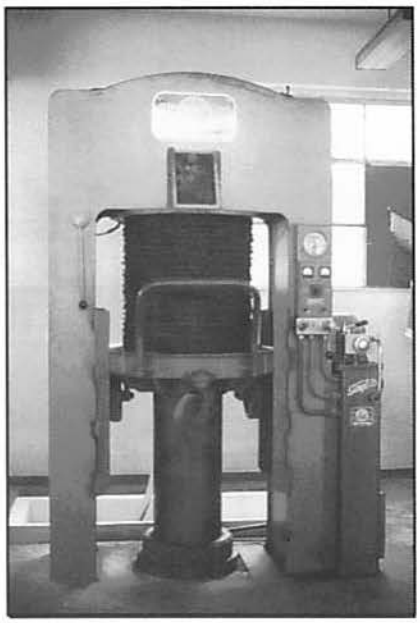


Figure 7. Pressing the olives.

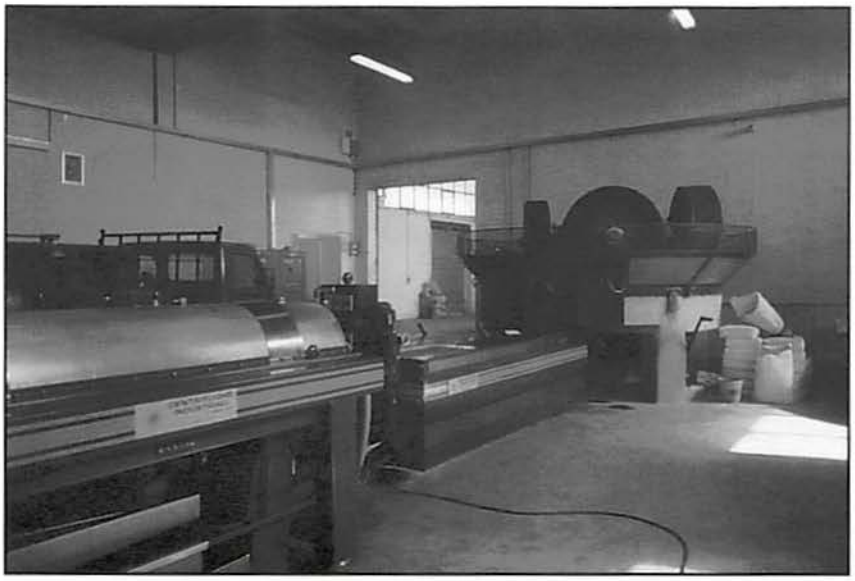


Figure 8. Continuous centrifugation plant.

the vegetable water. Old methods simply placed the extract in tanks and skimmed off (decanted) the less-dense oil as it rose to the top (fig. 10). More modern techniques use centrifugation to gather the oil.

Oil extracted by these processes is called the "first cold pressing" because no heat or chemicals are applied. About 65 to 90 percent of the oil is extracted by this first pressing, and this is the highest-quality oil, retaining its original color and flavor. Such oils are rated "true virgin oils." No other vegetable oil is edible following a first pressing.

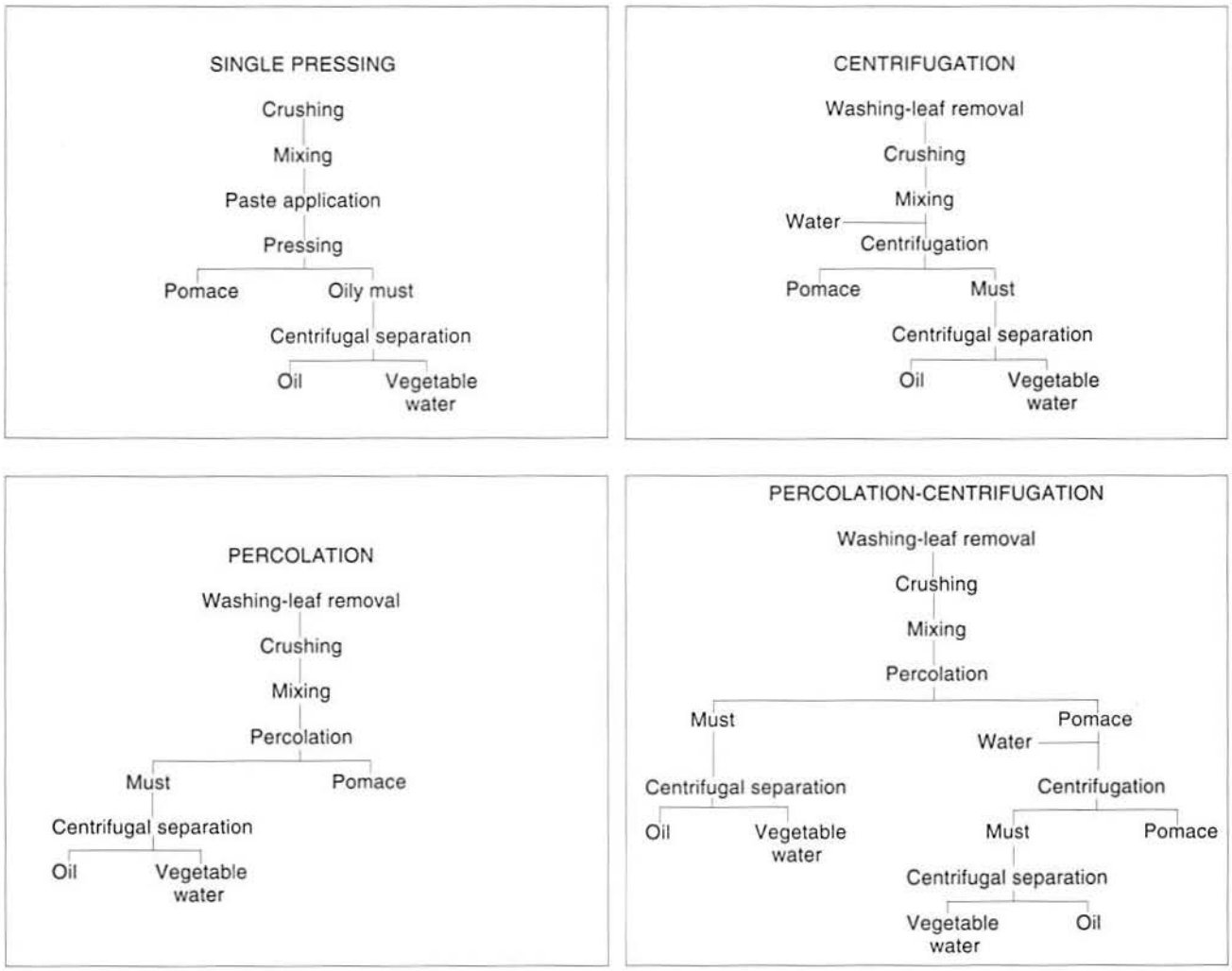


Figure 9. Olive oil separation processes.

The paste or mash is pressed a second and third time using heated water to extract more oil. This process, called hot pressing, produces oil of lesser quality with a higher acid content.

Solvents are used in the final pressing to extract the oil. Oil extracted from this process, called "residue oil," is highly colored and is strong in taste and acidity. Such oils are unfit for consumption unless refined. Olive oils that are refined are commonly mixed with virgin olive oil to make a salable olive oil.

Figure 10. Small-scale olive oil decanter.

Appendix: Glossary of Characteristic Flavors of Olive Oils

Almond. This flavor may occur in two forms. One is typical of the fresh almond; the other is peculiar to dried, sound almonds, and can be confused with incipient rancidity. A distinctive taste is perceived as an aftertaste when the oil remains in contact with the tongue and the palate. This flavor is associated with sweet oils that have a flat odor.

Apple. Flavor of olive oil reminiscent of this fruit.

Atrojado (fusty). Characteristic flavor of oil obtained from olives stored in piles that have undergone an advanced stage of fermentation.

Bitter. Taste of oils obtained from green olives or olives turning color. It can be more or less pleasant, depending on its intensity.

Brine. Flavor of oil extracted from olives preserved in saline solutions.

Cucumber. Flavor produced when an oil is hermetically packed for too long, particularly in tin containers. The flavor is attributed to the formation of 2.6 nonadienal.

Earthy. Characteristic flavor of oil obtained from olives collected with earth or mud on them and not washed. This flavor may sometimes be accompanied by a musty-humid flavor.

Esparto. Taste of oil obtained from olives pressed in new esparto mats. The flavor may differ depending on whether the mats are made of green esparto or dried esparto.

Flat or smooth. Flavor of olive oil whose organoleptic characteristics are very weak owing to the loss of their aromatic components.

Fruity. Flavor reminiscent of both the odor and taste of sound, fresh fruit picked at its optimal stage of ripeness.

Grass. Characteristic flavor of certain oils reminiscent of recently mown grass.

Greasy. Odor in olive oil extracted in a processing plant where residues of petroleum, grease, or mineral oil have not been properly removed from the machinery.

Green leaves (bitter). Flavor of oil obtained from excessively green olives or olives that have been crushed with leaves and twigs.

Grubby. Apparent oil flavor arising from olives that have been heavily attacked by the grubs of the olive fly (*Dacus oleae*).

Harsh. Characteristic sensation of certain oils that produce a mouth-feel of astringency.

Hay. Characteristic flavor of certain oils reminiscent of more-or-less dried grass.

Heated or burnt. Characteristic flavor of oils caused by excessive and/or prolonged heating during processing, particularly when the paste is thermally mixed, if this is done under unsuitable conditions.

Metallic. Flavor that is reminiscent of metal. Characteristic of oils that have been in prolonged contact, under unsuitable conditions, with foodstuffs or metallic surfaces during crushing, mixing, pressing, or storage.

Muddy sediment. Flavor of oil recovered from the decanted sediment in vats and underground tanks.

Mustiness-humidity. Characteristic flavor of oils obtained from olive fruit in which large numbers of fungi and yeasts have developed, as a result of its being stored in piles, in humid conditions, for several days.

Old. The taste of oil kept too long in storage containers. May also appear in oils that have been packed for an excessively long period.

Pomace. Oil having a flavor reminiscent of the flavor of olive pomace.

Pressing mat. Characteristic flavor of oil obtained from olives that have been pressed in dirty pressing mats in which fermented residues have been left.

Rancid. Flavor common to all oils and fats that have undergone a process of auto-oxidation caused by prolonged contact with the air. Rancid oil is unhealthy and unpleasant; it cannot be corrected.

Ripely fruity. Flavor of olive oil obtained from ripe fruit, generally having a somewhat flat odor and a sweet taste.

Rough. A perceptible taste in certain oils, which, when tasted, produces a thick, pasty mouth-feel sensation.

Soapy. Flavor producing an olfactory-gustatory sensation reminiscent of that produced by green soap.

Sweet. Pleasant taste, not exactly sugary, but found in oil in which the bitter astringent and pungent attributes do not predominate.

Vegetable water. Characteristic flavor acquired by the oil as a result of poor decantation and prolonged contact with vegetable water.

Winey-vinegary. A taste in certain oils reminiscent of wine or vinegar. Due mainly to the formation of acetic acid, ethyl acetate, and ethanol in larger amounts than is usual in the aroma of olive oil.

BIBLOGRAPHY

Di Giovacchino, L. 1991. Olive Oil Extraction by Pressing, Centrifugation and Percolation: Effect of Extraction Methods on Oil Yields. *Olivae* 36, Madrid, Spain, April 1991.

Dolamore, A. 1988. *The Essential Olive Oil Companion*. Macmillan Ltd., London, England.

Fabricant, F. 1989. Olive Oil: Mediterranean Gold Rush. *New York Times*, June 7, 1989.

Hartmann, H. T., et al. 1951. *Olive Varieties*. University of California Agricultural Experiment Station, Bulletin 720.

Hartmann, H. T., et al. 1980. *Olive Production in California*. University of California Division of Agricultural Sciences, Leaflet 2474.

Istituto Sperimentale per la Elaiotecnica Pescara (Italy). 1990. *Olive Oil Quality Improvement*. Collection: Technical Handbooks, International Olive Oil Council, Madrid, Spain.

International Agreement on Olive Oil and Table Olives. 1986. United Nations Depositary Notification: C.N. 262.1990. Treaties-2.

International Trade Standards Applying to Olive Oils and Olive-Pomace Oils. 1987. International Olive Oil Council, Madrid, Spain.

Klein, M. B. 1983. *The Feast of the Olive*. Harris Publishing Co., Berkeley, California.

Miscellaneous. *Olivae*. Bi-monthly publication of the International Olive Oil Council, Madrid, Spain.

Organoleptic Assessment of Virgin Olive Oil. 1987. International Olive Oil Council, Madrid, Spain, June 18, 1987.

U.S. Food & Drug Administration Regulations. Part 102: *Common or Usual Name for Nonstandardized Foods*, Parts A & B.